ARITHMETIC

IN

Primary and Grammar Schools.

By FRANCIS A. WALKER.

ARITHMETIC

IN

PRIMARY AND GRAMMAR SCHOOLS.

REMARKS OF MR. WALKER

IN

THE SCHOOL COMMITTEE OF BOSTON,

APRIL 12, 1887.

BOSTON
DAMRELL & UPHAM
The Old Corner Bookstore
283 Washington Street
1887

PRINTED BY
RAND AVERY COMPANY,
BOSTON, MASS.

ARITHMETIC IN PRIMARY AND GRAMMAR SCHOOLS.

At the stated meeting of the School Committee of Boston, on the 12th of April, 1887, Mr. Crowley, for the Committee on Examinations, to whom was referred an order introduced early in the winter by Mr. Walker, relating to the study of arithmetic, presented a report[1] embracing the recommendations, that home lessons in arithmetic should be given only in exceptional cases; that certain branches now included in the course of studies be omitted; that the average time devoted to arithmetic throughout the primary and grammar schools should not exceed three hours and a half a week; and that all examinations for promotion from primary to grammar schools should be as simple as possible. The report closed with an order authorizing the Committee on Examinations to revise and alter the course of study so far as should be rendered necessary by the adoption of these recommendations. Mr. Walker then addressed the Board, as follows: —

Mr. President and Gentlemen, — When I moved, last winter, the resolution which has become the subject of

[1] The text of the recommendations made by the Committee will be found on the last pages of this pamphlet.

the report of the Committee on Examinations this evening, it was without any purpose of taking part in the inquiry proposed. But the course of public discussion since that time, and my own appointment to the Committee on Examinations, have seemed to require something to be said by me regarding those features of the study of arithmetic in our common schools to which exception has been taken, and which the Committee, through their chairman, have unanimously recommended should be reformed in part or reformed altogether. And first it may be said, that, if there be any reason whatsoever for believing that the course in arithmetic can be simplified and shortened, the matter is not one of slight importance. The cry of overwork frequently comes from pupils, parents, and physicians who are undoubtedly sincere, even if mistaken in this view; while if we reject the plea of overwork, and conclude that the amount of study required of our children is, as an aggregate, not too large, we still have to encounter the almost unanimous complaint of teachers that studies are set down in the official courses which they have not time to teach as they ought to be taught, many going so far as to say that it would be better that some of these subjects should not be broached at all if they are not to be dealt with more thoroughly and systematically than is possible at present with the time allowed. If, then, the course in arithmetic can be abridged, without injury on that side of our public schools, we know very well what to do with the time so released. It may

be applied, in the discretion of the School Board, either in relieving the pupils from the general strain of their work, or in allowing the further cultivation of natural science, or in affording additional practice in the art of observation, or in making way for the new mechanical and industrial exercises demanded by so many of our citizens.

IMPORTANCE OF ARITHMETICAL STUDY.

Let me not be understood as disparaging the importance of the proper study of arithmetic in our public schools.

No one has a higher appreciation of the vital, practical importance of having our children taught to perform ordinary arithmetical operations with absolute accuracy, and with a good degree of facility. Indeed, it is one of the gravest accusations brought against our public schools, as at present administered, that the old-fashioned readiness and correctness of "ciphering" have been, to a large degree, sacrificed by the methods which it is now proposed to reform. A false arithmetic has grown up, and has largely crowded out of place that true arithmetic which is nothing but the art of numbers. But to this point there will be a more fitting occasion to advert further on. The question as to the amount of arithmetical study at present desirable, cannot be properly understood without reference to the courses of study in our schools a generation ago. At that time, with the whole week, excepting only Saturday afternoon, at the disposal of the teacher, the studies in the district school were few

and simple. Reading, writing, and arithmetic, a little grammar, and a little political geography, made up substantially the course of study. In this condition there was not only no reason to scrutinize carefully the amount of time used for arithmetic, but that study was naturally and properly looked to for a considerable part of the mental training of the child. Increasingly, within the last thirty, twenty, and ten years, new studies in great variety have been introduced into our school courses, some of which are better suited for the purposes of intellectual training than arithmetic itself.

Thus we have, in addition to the simple political geography of an earlier day, the extended study of physical geography, rising into what were once the mysteries of meteorology.

OFFICIAL COURSE OF STUDY.

In illustration of this point, allow me to quote from the official course of study, as revised and simplified in 1885: —

Class IV. (Three hours a week). — Second stage of the study of geography. 1. Study of the earth as a globe; simple illustrations and statements with reference to form; size; meridians and parallels, with their use; motions, and their effects; zones, with their characteristics; winds and ocean currents; climate as affecting the life of man (occupations, manners, customs, etc.)

2. Physical features and conditions of North America, South America, and Europe studied and compared: position on the globe; position relative to other grand divisions; size; form; sur-

face; drainage; climate; life (vegetable, animal, human); regions adapted to mining, agriculture, etc.; natural advantages of cities; comparison of physical features and conditions of one grand division with those of other grand divisions. Map-drawing as the study of each grand division proceeds. Other grand divisions to be studied if there be time.

Such are the subjects now prescribed for our children of eleven and twelve years of age. After the completion of this body of study, the child has still three years of geographical study before graduating from the grammar school. Again, we have a large body of elementary science, extended through the nine years of the primary and grammar schools, regarding which I will only quote the curriculum of two years: —

Class II. (One hour and thirty minutes a week). — Physiology and hygiene.

1. Growth and renewal of the parts of the body, how secured.

(*a*) The digestive apparatus and digestion. Food, the quality and quantity of, etc.

(*b*) Circulation, the organs of. The blood as a circulating medium.

(*c*) Respiration, the organs of. Ventilation. The vocal apparatus.

2. (*a*) The digestive organs of man and other animals, compared. (*b*) Their modes of breathing, compared. (*c*) The amount of animal heat, compared.

Class I. (Two hours a week). — Physics. Common facts learned from observation and experiment, in regard to as many of the following topics as the assigned time will allow: 1, matter, its properties, its three states; 2, motion and force, laws of motion;

3, gravitation; equilibrium, pendulum; 4, lever, wheel and axle, pulley, inclined plane, wedge, screw; 5, liquid pressure; specific gravity; 6, atmospheric pressure; barometer, pumps, siphon; 7, electricity, frictional and current; conductors, magnetism, compass, magnetic telegraph; 8, sound; pitch of sounds, echoes, acoustic tubes; 9, heat; diffusion, effects, thermometers; 10, light; reflection, refraction, lenses, solar spectrum, color.

But these are not all the new subjects to which pupils are now required to give their time and attention. In addition to the old-fashioned "parsing," with an occasional composition, we now have studies in English literature and the history of the English language justifying, it would appear, such questions on examination as "changes in the English language from the time of the Norman conquest to the death of Chaucer," a question unknown to the high school and preparatory academy of a generation ago, and even to the earlier years of the college curriculum. Moreover, we have music and drawing pursued systematically and at great length through the entire course of the primary and the grammar school. It is not necessary to take the time of the Committee for further enumeration of subjects of study which have been forced into the school-week, which is certainly no longer than it was a generation ago, and which is shorter by one-half of Saturday. It is evident, that, if so much must come in, something must go out to make room for it; and, secondly, that we have, in these new studies, means for much of that training of the child's powers

which our fathers looked to arithmetic to accomplish. "That mathematics can," says Sir William Hamilton, "possibly, in their study, educate to any active exercise of the power of observation, either as reflected upon ourselves, or as directed on the affairs of life and the phenomena of nature, will not, we presume, be maintained." "That they do not cultivate the power of generalization," he continues, "is equally apparent." "But the study of mathematical demonstration is mainly recommended as a practice of reasoning in general; and it is precisely as such a practice that its inutility is perhaps the greatest." "Are mathematics, then," he concludes, "of no value as an instrument of mental culture? To this we answer, that their study, if pursued in moderation, and efficiently counteracted, may be beneficial in the correction of a certain vice, and in the formation of its corresponding virtue. The vice is the habit of mental distraction; the virtue, the habit of continuous attention. This is the single benefit to which the study of mathematics can justly pretend, in the cultivation of the mind."

Such was the opinion of England's greatest philosopher, in this century, at least. Reverting, now, to the course of study in the primary and grammar schools of Boston, I do not hesitate to say that some of the new subjects of study, if properly pursued, will not only educate to an active exercise of the power of observation, will not only cultivate the power of generalization, will not only afford excellent practice of reasoning in general,

but will also serve to create the habit of continuous attention, as well as, or even better than, mathematics. Certainly the attention given by a class of interested children, in the study of natural history, under a good teacher, is far closer, and much more truly educational, than the attention given by pupils who are driven reluctantly through an arid waste of mathematics.

I reach the conclusion, then, that not only the demands upon the time of our pupils, but the character of the subjects of study, new to this age, justifies and requires that arithmetic be restricted to that amount which is needed to give facility and accuracy, in ordinary numerical operations, with a view to the use to which this power is to be put, either in practical life, or in subsequent and higher studies. The amount of time now expended upon the study of arithmetic by the revised course is as follows: In the primary school, class 3, three hours thirty minutes per week; class 2, four hours; class 1, four hours thirty minutes. Grammar school, class 6, four hours thirty minutes per week; class 5, four hours thirty minutes; class 4, five hours; class 3, five hours; class 2, four hours thirty minutes; class 1, four hours. During the second half of the last year, two hours and a half additional per week are devoted to the study of book-keeping; but to this I shall not advert.

It appears, therefore, that nearly four hours and a half a week, or almost exactly one-fifth of the entire school-time, are devoted to the study of arithmetic, on the aver-

age, during the nine years of school-life, according to the prescribed courses. But it also appears, from the results of an investigation made last winter at the instance of this Committee, that this allowance of time is, in many cases, exceeded, in some cases exceeded considerably, during school-hours; while it also appears that in thirty-six school-districts home lessons are, to a greater or less extent, assigned in arithmetic. It is in the belief that our pupils could acquire all needed facility and accuracy in numerical operations in less than the time now devoted to arithmetic, that the Committee have included in their report two propositions, — one, that home lessons in arithmetic shall be given out in exceptional cases only; another, to establish the average time to be devoted to the study of arithmetic at three hours and a half per week. It is my personal belief that this reduction may ultimately proceed even further to advantage, and that the average child could acquire as much accuracy and facility in this regard as would be desired, if properly instructed in simple numerical operations for three hours a week through a term of five years.

At the present time the results in accuracy, if not in facility, of arithmetical work leave very much to be desired. Scarcely has the child been taught to count as high as ten, when he is put at technical applications of arithmetic, to money coins, to divisions of time, space, etc.; and these technical applications are increased in number and in difficulty through the successive years of

the grammar school, until for a large amount of so-called arithmetic the pupil gets comparatively little practice in the art of numbers. I am far from saying that the pupils of our public schools should not acquire a certain amount of useful information. The most familiar "tables" of lengths, weights, measures, and coins may properly be given them, and they may advantageously be practised in simple operations thereunder. But this whole matter of the technical applications of arithmetic should be treated in a highly conservative spirit. Of late years, there has been some reform in this particular, and a few of the monstrosities of the old curriculum, notably our ancient enemy, duodecimals, have been thrown overboard. But there still remain many things, as taught in our schools, which occupy time that could better be devoted to the study of other subjects, or, at least, to a greater degree of practice in simple operations. The report of the Committee on Examinations contains propositions for a very extensive retrenchment on this side. Compound interest, compound proportion, compound partnership, cube root and its applications, equation of payments, exchange, "similar surfaces," and the mensuration of the trapezoid and trapezium, of the prism, pyramid, cone, and sphere, are proposed to be dropped from the course in the grammar school. If these subjects are to be studied, it should be in the high school. Another change in this direction is in the proposition to remove from the grammar school the study of the metric system.

The Committee believe, that, in the present state of our laws and commercial usages, the metric system is a proper subject for extended study in high schools only. The introduction of this subject so widely into the public schools of the United States has been due, not to an appreciation of the practical advantages of this instruction to the existing body of pupils, but to a propaganda for the promotion of legislation on the part of Congress and the legislatures of the several States, looking to the general adoption of the metric system. The Committee object to having the children of Boston used any longer as an agency for promoting that object, however in itself desirable. Not one child in a hundred, or in three hundred, who has left the schools of Massachusetts during the last ten years, to go to work, has ever once had occasion to use the metric system for any practical purpose. The few who may be called to make use of this system could readily acquire such portions of it as they might need, from their employers or their fellow employés. In pursuit of the same object, it is further provided in the report of the Committee, that all exercises in fractions, commission, discount, and proportion shall be confined to small sums and to simple subjects and processes, the main purpose throughout being to secure accuracy and a reasonable degree of facility in plain, ordinary ciphering. Who of us has not seen in the hands of children of eleven, twelve, and thirteen years of age, examples in "compound and complex fractions" which were more difficult than

any operation which any bank cashier in the city of Boston has occasion to perform, in the course of his business, from January to December? The most jagged fractions, such as would hardly ever be found in actual business operations, e.g., 11–29 or 13–27, are piled one on top of another, to produce an unreal and impossible difficulty; and the child, having been furnished with such an arithmetical monstrosity, is set to multiplying or dividing it by another "compound and complex fraction" as unreal and ridiculous as itself. All this sort of thing in the teaching of young children is either useless or mischievous. It is bad psychology, bad physiology, and bad pedagogics. Every pupil, by the time he leaves the grammar school, should be taught to use small sums infallibly, in multiplication and division, and to add columns of figures as long as an ordinary housekeeper's book or bank deposit book, almost beyond the possibility of ever committing an error. This nearly every child of ordinary brightness can be brought to do, and that in a small part of the time now devoted to the so-called study of arithmetic. It is not necessary that the pupil should be brought to do this thing with rapidity. Only a reasonable facility should be aimed at. If a boy is to go into some line of work where figures are used only incidentally and occasionally, he will have facility enough for the purpose. It is only necessary that he should be infallibly accurate; and this any good teacher ought to be able to secure in five years, seven years, or nine years of drill. If, on the

other hand, a boy is to go into a position where his main work is to be concerned with figures, he will readily enough acquire the necessary facility, if only accuracy has been secured during the years of especial mental growth and training. If, however, his training has been loose and unsystematic, no amount of practice will give him accuracy; the faster he works, the more mistakes he will make. Nor is it easy, if, indeed, it be at all practicable, to remedy the defects of early education in the case of one who has passed the age of fifteen or sixteen without that training and drill in the use of figures, which would make mistakes in simple arithmetical operations almost impossible. Unfortunately, in this matter of inaccuracy in the use of figures, resulting from the manner in which arithmetic is now taught in our schools, the evidence is overwhelming in character and amount. Our technical schools receive pupils from the high schools, who, while they understand difficult theorems, and are masters of complicated algebraic formulæ, make mistakes in the simplest arithmetical operations. If the high schools are blamed for this, the masters justify themselves by alleging that pupils come to them — as a high-school teacher said to me within two weeks — without being able to add or multiply, to subtract and divide, or even to count, with accuracy.

The grammar-school masters, if appealed to, are obliged to admit the deficiencies of their graduates; but they ask, what better can be expected when only a small fraction,

often a contemptibly small fraction, of the time nominally devoted to the study of arithmetic, can be given to numerical operations, consistently with bringing their pupils up to the bar, duly loaded and primed for examination in countless technical applications of arithmetical rules, and consistently with giving them that flexibility for the purposes of arithmetical gymnastics, which the practical and illustrative problems of the text-books require.

But it is not alone the teachers of the high schools who have occasion to complain of the way in which the study of arithmetic is conducted under the prevailing system. The employers of those boys and girls who leave the grammar school to go to work, have occasion to complain, and do complain bitterly of the deficiencies of our instruction on this side. After very extensive inquiries, conducted through the past year, I do not find it possible to entertain a doubt that the old-fashioned facility and accuracy in ciphering have been largely sacrificed to the numerous technical applications and difficult logical puzzles which have been introduced into the instruction in arithmetic, and that our children leave the schools very ill-prepared, in this respect, for the practical work of life. Now, if any greater wrong, short of a permanent injury to health, can be done a child, than to send him into the world to earn his living, without the ability to conduct numerical operations accurately and with reasonable facility, it would be difficult to see what that injury would consist of. Employers have, literally, no use for boys

who make mistakes in numbers. Such a failing offsets the best training, otherwise, of mind and hand.

In a store or shop or factory, or on a railroad, a lad who cannot set down figures and add them rightly every time is little better than a cripple. The master of one of our high schools told me recently, that he was informed by the president of a Boston bank, that, at an examination held during the year with reference to an appointment in his institution, out of several graduates of various high schools of this vicinity, not one was found able to add the columns of figures given him, without errors. It is little wonder that this should be the result, when, of the time devoted to arithmetic, four-fifths or nine-tenths are occupied by technical applications of numerical principles, or are worse than wasted by logical puzzles unsuited to the child's age and mental strength.

And this last remark brings me to the hardest accusation which is to be brought against the current teaching of arithmetic. Well aware that at this point we have to encounter an inveterate superstition of the New England mind, I have armed myself as much as possible with authority derived from men of the ripest wisdom and the largest learning in mental science. The charge I make against the existing course of study is, that it is largely made up of exercises which are not exercises in arithmetic at all, or principally, but are exercises in logic; and secondly, that, as exercises in logic, these are either useless or mischievous. The class of exercises that are here

in mind will be easily apprehended. They are those where an example, or so-called practical problem, is given in figures and words which are to be reduced to the form of figures and algebraic signs, and thereupon the performance of the indicated numerical operations will yield the required result. It would, perhaps, be going too far to say that such examples should in no case be given; but it may be unhesitatingly asserted, that wherever the "statement" which is preliminary to the performance of the purely arithmetical operations involves a great deal of trouble, time, and thought, while the mere ciphering which follows is done in a minute, as a matter of course, such exercises are not exercises in arithmetic, but in logic.

Secondly, if such exercises, of any considerable degree of difficulty, are to be set at all for the pupils in our public schools, they should be prescribed as exercises in logic, or the art of reasoning; they should be taken from books prepared by eminent teachers of the science of mind, who are qualified to decide as to the degree of difficulty in logical exercises which is suitable to the child of this or that age; and the exercises so prescribed should be conducted by persons themselves trained and qualified to teach the art of reasoning. To smuggle exercises of this character into instruction given in the name of arithmetic, is an abuse. By it has been created a bastard arithmetic which fails to perform the true function of that study in our public schools—namely, to produce accuracy and a reasonable degree of facility in numerical operations—while wast-

ing the time of the pupils, perplexing their minds, worrying their tempers, rasping their nerves, and, in case of total or partial failure, unnecessarily and unrighteously shocking and impairing their self-respect and scholarly ambition.

Does any one consider this an extravagant denunciation of exercises of the character indicated? I ask, is there any father who has had children in the public schools of Boston, where arithmetic is used as a home lesson, who has not seen those children puzzling and worrying ten, fifteen, or twenty minutes over a "practical problem," the purely numerical work of which would not occupy as many seconds; and, after an evening spent in this way, going to bed hot, tired, and perhaps tearful, and altogether unfitted for that sound and healthful sleep which should close every child's day? I have myself had four children in the grammar schools of this city or of New Haven, where home lessons in arithmetic were allowed. Each one of these in turn I have seen tormented in this way; and have myself, not infrequently, when stooping to aid them, that they might go to bed in something like Christian season, been not a little perplexed and troubled to make the statements required. Doubtless this has been the experience of most parents; and doubtless, too, this practice would long since have been reformed, but for the inveterate superstition of the New England mind, that it is well the child should be worried and perplexed in education, and that out of this agitation of the nerves and this strain upon the mental

powers, proceed health and vigor. Such a view is everywhere yielding to a better study of the laws of mind. Generally, if not universally, speaking, whatever in education is hard is wrong. The true mental gymnastic for growing children is through exercises easy and pleasant, which lead insensibly up to ever higher planes of attainment, as the faculties are expanded and strengthened according to their own law of growth, aided and fostered by gentle and agreeable practice.

It is in my power to present to the Committee the results of an experiment, on a sufficiently large scale to establish the truth of these representations regarding the difficulty of many of the sums and problems set for the pupils of our public schools. Fourteen examples, taken from the arithmetic in use in our schools, were given out to a large number of pupils of the three upper classes in four of our grammar schools. These examples were not the most difficult which could have been taken for the purpose. On the contrary, a number of the examples first selected were thrown out, upon the representation of the masters that they would be found so difficult as to produce a general failure. The following represents the percentage of successful answers in each case: —

Example.	Per cent.	Example.	Per cent.
1	69	8	53
2	16	9	65
3	47	10	38
4	67	11	49
5	46	12	51
6	56	13	70
7	86	14	39

But it is not merely to the degree of difficulty attaching to exercises of this character to which exception should be taken. I desire to challenge peremptorily the whole policy of giving out exercises of any appreciable degree of logical difficulty to children of this age. Thoroughly convinced that such a practice involves, to repeat the phrase already used, bad psychology, bad physiology, and bad pedagogics, I was yet desirous of bringing to my support the authority of masters in mental science, and, with this view, addressed communications to Professor William James, professor of psychology in Harvard University; Professor George H. Howison, professor of philosophy in the University of California; Professor G. Stanley Hall, professor of pedagogics in the Johns Hopkins University, and Dr. Noah Porter, late president of Yale College, and still professor of mental and moral science in that institution. The purport of these communications was to inquire, first, whether the faculty of logical analysis is not one which, in the case of the vast majority of children, normally develops at a later period than that within our present consideration; secondly, whether if this be so, there is any pedagogical advantage in attempting to "pry up" this faculty and bring it prematurely into consciousness and exercise, instead of devoting the time and strength of young pupils to the formation of a habit of observation, to the cultivation of the powers of perception, to practise in the interpretation of personally observed phenomena, to the acqui-

sition of elementary information, and to the development, in a reasonable degree, of strength and clearness in the memory. The class of exercises to which exception has been taken were illustrated either by sufficient description or by actual examples. To these communications the most courteous replies have been received. The essential parts are here submitted, without apology for their length, on account of the great interest of the subject treated and the high and commanding reputation of the authors.

Professor James writes: "The elaborate combinations of arithmetical data of which you write are certainly given to children before there brains are very hot for them; while I imagine, on the contrary, the mere operations of arithmetic are a comparatively congenial exercise. It is, as you say, in the association of concretes that the child's mind takes most delight. Working out results by rule of thumb, learning to name things when they see them, drawing maps, learning languages, seem to me the most appropriate activities for children under thirteen to be engaged in. Anecdotical history (without political ideas) might be added. I feel pretty confident that no man will be the worse analyst or reasoner or mathematician at twenty for lying fallow in these respects during his entire childhood."

Professor Stanley Hall writes: "If I correctly understand your position, I most emphatically agree with it. The purer the mathematics for boys of from ten to fourteen

years of age, the better, it seems to me. Many of our arithmetics presuppose algebra and geometry; i.e., in the latter part give examples that can be done easily by those methods, but which require students to go through long and tedious processes, which algebra and geometry were meant to short-circuit. Problems in brokerage, surveying of land, architecture, custom-house practices, etc., are taught just as in the old Hindoo mathematics a taste for poetry, and in mediæval arithmetics moral and religious maxims, and even systems, as well as historical information, were inculcated in the form of 'sums.' Has modern business really any more place at that stage? . . . American teachers seem to me to have spun the simple and immediate relations and properties of numbers over with pedantic difficulties. The four rules, fractions, factoring, decimals, proportion, per cent, and roots, is not this all that is essential? The best European text-books I know do only this, and are in the smaller compass, for they look only at facility in pure number-relations, which is hindered by the irrelevant material publishers and bad teachers use as padding."

Professor Howison writes: "I understand your question to bear simply on the point whether I consider the class of arithmetical exercises, to which you refer, and in which the work turns almost entirely on the logical relations of the numbers given in each example, to be a wholesome *regimen* for pupils in the common schools, of ages from eleven to thirteen years. To this I reply, first, that on gen-

eral principles such exercises in reasoning upon the combinative relations of numbers, or numbered objects, ought to play a very subordinate part in the elementary period of instruction of arithmetic. But nevertheless, secondly, as the very life of arithmetical power turns on ability to make the logical synthesis involved in the latter kind of work (you see, I do not reckon them mere analyses, as is usually done), I think some exercises of this sort should go along with the other simpler and more natural kind, and that they should go from the earliest practicable date, almost from the beginning. But the combinative reasoning should be adjusted in the most careful and considerate manner, with a reference, that is, to the degree of difficulty with which the mind of a child is able at each date to cope, without confusion, and without sense of strain. So, thirdly, I should say that the question you raise concerns, mainly, a matter of more or less — a matter of degree. It is not that the class of exercises to which you refer are in kind and of necessity wrong, but that the complexity and difficulty of those actually given are so often out of all proportion to the healthy capacities of children at the age involved. . . . My own experience and opinion of many details in the arithmetics made for boys and girls of the age to which you refer are quite like yours. And my experience and my theories, founded on my professional studies and practice, have alike made it with me a matter of settled conviction that not only in mathematical, but in all elementary teaching,

though in elementary mathematical teaching pre-eminently, the first thing is to get the pupil perfectly familiar with, and as nearly as possible infallibly accurate, in fundamental facts and operations. . . . I believe our current practice in this reference has for some years — say the last thirty — been going seriously wrong. The re-action from the exaggerated rote work of the preceding period has driven us into the error of the opposite extreme.

"The attenuated thread into which grammar-school instruction is now 'long drawn out' should appear a patent absurdity to every thinking mind. Particularly is this absurdity manifest in the fact that we spend eight or nine years in nominally teaching arithmetic, when we ought to be able, surely, to accomplish all that is essential in three, or at the very utmost in four."

President Porter writes: "I am entirely with you in the opinion that the questions which you send me are unfit for pupils of fourteen or fifteen years, unless they have been subjected to a special training; and that, to subject persons of that age to such a training, would ordinarily do them more harm than good. . . . Nothing is so admirable, in its time and place, as the pure mathematics in every form. When these are properly taught, i.e., when they have trained the mind to sharp analysis and patient synthesis, by the use of numbers and geometric forms, they prepare the way for the higher forms of logical analysis and synthesis, and, last of all, for invention, — the invention which is presupposed in the problems to which you reasonably object."

It is for the reasons which have been given, re-enforced by the authority of the eminent teachers who have been cited, that the Committee have included in their recommendations a rule which would require that all practical and illustrative problems should be of a nature to interest and to aid the pupils in their strictly arithmetical work, not to throw obstacles in their way or increase the difficulty of that work; it being expressly provided that all problems where an attentive and diligent pupil of ordinary capacity would find any considerable degree of difficulty in making the "statement" preliminary to the performance of the numerical operations required, shall be deemed objectionable.

RECOMMENDATIONS OF COMMITTEE ON EXAMINATIONS.

THE following were the recommendations of the Committee on Examinations, referred to in the preceding remarks: —

1. Home lessons in arithmetic should be given out only in exceptional cases.

2. The mensuration of the trapezoid and of the trapezium, of the prism, pyramid, cone, and sphere, compound interest, cube root and its applications, equation of payments, exchange, similar surfaces, metric system, compound proportion, and compound partnership, should not be included in the required course.

3. All exercises in fractions, commission, discount, and proportion should be confined to small numbers, and to simple subjects and processes;

the main purpose throughout being to secure thoroughness, accuracy, and a reasonable degree of facility in plain, ordinary ciphering.

4. In "practical problems," and in examples illustrative of arithmetical principles, all exercises are to be avoided in which a fairly intelligent and attentive child of the age concerned would find any considerable difficulty in making the "statement" which is preliminary to the performance of the properly arithmetical operations.

When arithmetical work is put into the form of practical or illustrative problems, it must be for the purpose of interesting and aiding the child in the performance of the arithmetical operations, and with a view to their common utility.

5. In oral arithmetic no racing should be permitted, but the dictation should be of moderate rapidity.

6. The average time devoted to arithmetic throughout the primary and grammar school course should be three and a half hours a week; and in the third primary grade not more than two hours,

and in the first and second primary grades not more than three and a half hours per week.

7. All examinations for promotion from primary to grammar schools should be as simple as possible, and strictly confined within the limit of an hour in each subject.

DATE DUE